

## Effect of an educational program on nurses' competency about fluid, electrolyte and Acid Base disturbances among acute liver failure patients' outcomes

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### Abstract

**Background:** Competent nurses must be able to comprehend and manage a patient's fluid and electrolyte balance in order to provide critical care. Abnormalities in these bodily fluids can have catastrophic implications. **Aim:** Effectiveness of an educational program about fluid, electrolyte and Acid Base disturbances among acute liver failure patients on nurses' competency and patients' outcomes. **Patients and Methods:** quasi-experimental research design. **Participants:** A convenience sample of 50 nurses working in the intensive care unit at a liver hospital and eighty patients with acute liver failure. **Method:** Three tools were used to collect the data: the **Tool (I):** Before/after knowledge estimation questionnaire and the **Tool (II):** Before/after observational checklist. **Tool (III):** was a patients' outcomes evaluation sheet used to assess the effect of an educational program on nurses' competency about fluid, electrolyte, and acid base disturbances among acute liver failure and Patients' outcomes. **Results:** The majority of nurses have insufficient total knowledge before the teaching program; after the teaching program, the mean score improved significantly, and patients outcomes improved. **Conclusion:** Implementing a teaching program leads to important progress in nurses' knowledge and acute liver failure patients' outcomes. **Recommendations:** continuous In-service training programs for the purpose of updating nurse's knowledge and acute liver failure patients' outcomes.

**Keywords:** *Acute liver failure, Electrolyte & Educational program.*

### Introduction

While most cases of acute liver failure result in hyponatremia, patients with acute liver failure can maintain a normal electrolyte value however; this balance is susceptible to disruption with the advancement of infection impacting renal function (Jime nez1 et al, 2017). Electrolyte disturbances are involved in many disease processes, and are an important part of patient management (Masia & Misdraji, 2021). Electrolyte molecules, including potassium, chloride and sodium, are vital for sustaining bodily fluid equilibrium, promoting muscular elasticity, and transmitting neurological impulses to the brain (Abdulmajeed et al, 2020). Hepatic encephalopathy, coagulopathy, and severe and abrupt liver cell failure are the hallmarks of acute liver failure, a potentially fatal illness (Linda et al 2022). In order to expand, connect, and coordinate care for patients, nurses are essential. They are in a good position to offer safe and efficient care in the areas of illness avoidance and treatment because their training and experience. Ability to empower patients to advocate for their right to the highest quality of care; Ability to build rapport with patients and their families quickly and sensitively, taking into account the patients' declared and perceived cultures; Rehabilitation (Langins & Borgemans, 2015).

It's critical to create clear and concise definitions of nursing competency and competency levels so that more nurses may assess and improve their own nursing competencies in their practice. The Nurses Association developed nursing competency indices that could be used across all areas of nursing practice (the Japanese Nursing Association, 2015).

### Significance of the study:

Competency nurses play a major role in the management of fluid and electrolyte balance. So an educational program is important to increase knowledge and practice of nurses about assessment and management of fluid and electrolyte disturbances among acute liver failure patients' outcomes.

Fluid and electrolyte play a vital role in homeostasis within the body, fluid and electrolyte detected in critical ill patients with acute liver failure so it is essential for competency nurses to understand and monitoring a patient's fluid and electrolyte balance to providing critical care.

Lack knowledge and practice regarding fluid and electrolyte, and its management often has several obstacles. This study was carried out to investigate the effect of an educational program about fluid and electrolyte disturbances among acute liver failure patients' outcomes.

**Aim**

Effectiveness of an educational program about fluid, electrolyte and Acid Base disturbances among acute liver failure patients on nurses' competency and patients' outcomes.

**Methodology**

A quasi-experimental research design. This study was done between July 2022 and July 2023.

**Setting of the study:**

This study was carried out in 2 settings included:

- Tropical intensive care unit at Alrajhy liver hospital, Assiut University.
- Medical intensive care unit at Alrajhy liver hospital, Assiut University.

**Hypothesis:**

**The first hypothesis:** states that nurses enrolled in educational programs will have higher post-knowledge scores than pre-knowledge scores.

**The second hypothesis:** Nurses undergoing an educational program will have higher post-practice scores than pre-practice scores.

**The third hypothesis:** The knowledge and practice scores attained by nurses enrolled in educational programs will be positively correlated.

**The fourth hypothesis:** patients' outcomes will be improved after implementing the educational program.

**Participants**

- A convenience sample of all available fifty nurses working in Tropical and Medical Intensive Care Unit at Alrajhy liver hospital.
- Eighty patients with acute liver failure were selected by convenience sample into two equal groups control group forty patients and study group forty patients.

**Sample size**

A minimum of 80 patients will be needed for the study analysis, based on the previously reported frequency of acute liver cell failure, which was 8% (1), with a p-value < 0.05, 90% power, and a confidence level of 0.95. (Stravitz & Lee, 2019).

**Tools**

Three tools existed to gather data connected to the study:

**Tool (I):**

**Part (one):** Socio-demographic data of sample

**Part (two):** A total of (43) questions including knowledge about Fluids and Electrolytes disturbances among patients' with acute liver failure.

**System of scoring for nursing knowledge:** There were forty-three (43) questions in all. For every right response, a score of one was given; a zero was given for an incorrect response.

The whole knowledge mark of nurses was computed and categorized as: score of fewer than 60% was

deemed unacceptable, while a score of greater than 60% was deemed acceptable (Shashi et al 2023).

**Tool (II):** Formed of the following steps;

- Monitoring fluid balance: which included (18) steps
- Intravenous cannulation: which included (32) steps.
- IV infusion: which included (25) steps.
- Nursing considerations for intravenous albumin replacement: which included (6) steps.
- Nursing consideration for potassium replacement: which included (8) steps.

**System of scoring for nursing skills:** The total score for all steps were (89) and every step was evaluated as follows: For every right response, a score of one was given; a zero was given for an incorrect response.

**Tool (III):** The third tool was Patients' outcomes evaluation sheet which included:

**Part 1:** Socio-demographic data.

**Part 2:** Physical Examination Assessment, which was developed by the researcher

**Part 3:** Laboratory Assessment

**Part 4:** Evaluation of acute liver failure patients' outcomes, which was developed by the researcher to assess the effect of an educational program on nurses' competency about fluid, electrolyte, and acid base disturbances among acute liver failure and Patients' outcomes it include:

1. Length of stay
2. Complications such as:
  - Acute respiratory failure.
  - Infections and sepsis.
  - Cardiac dysfunction, hypotension.
  - Hepatorenal failure.
  - Hemorrhage.
  - cerebral edema
  - Others
3. Mortality

**Method**

- Assess nurses' information about fluid and electrolyte disturbances in patients with acute liver failure to decide their informative wants.
- Assess nurses' practice.
- The development of tools was done after reviewing the related literature.
- Content validity was measured using Cronbach's test. The degree of Cronbach's alpha was 0.93, with a confidence interval of 0.88 to 0.95. Based on the effect of dropping variables, none of these parts of the questionnaire are required to be reversed.
- A pilot study was conducted on five nurses and eight patients to test the feasibility and applicability of the tools and the analysis of the pilot study revealed that minimal modifications are required, these necessary modifications were done and the pilot study subjects were excluded from the actual study.

**Ethical consideration:**

- Research proposal was approved from Ethical Committee in the faculty of nursing.
- There was no risk for study subject during application of the study.
- The study followed common ethical principles in clinical research.
- Written consent was obtained from patients or guidance that participated in the study, after explaining the nature and purpose of the study.
- Patient was assured that the data of this research was not be reused without second permission.
- Confidentiality and anonymity was assured.
- Patients had the right to refuse to participate or withdraw from the study without any rational at any time.
- ✚ Data was assured of confidentiality and anonymity.
- ✚ Building the program:
- ✚ The researcher generated the teaching program from the consequences of the earlier evaluation of the knowledge and abilities of nurses, accessible resources as well as an analysis of pertinent literature.
- ✚ Implementation of program:
  - The program was implemented for the five subgroups of nurses. All groups were exposed to three sessions in addition to the preliminary one.
  - Preliminary session: In this session the researcher met the participant face to face and explained the objectives, contents, methods of evaluation of program, Anatomy and function of liver. For duration of 30 minutes.
  - Session I included: Definition of acute liver failure, Causes of acute liver failure, Clinical Manifestations and categories of acute hepatic failure. For duration of 30 minutes.
  - Session II included: List Complications of acute liver failure, Apply Collaborative management of patient with acute liver failure and electrolyte imbalance in patient with acute Liver Failure. For duration of 30 minutes.
  - Session III included : Identify Acid-Base Balance, Identify laboratory Values of Electrolytes and Acid-Base, Recognize Normal Intake and Output in patient with acute Liver Failure, List symptoms and adverse clinical effects of fluid and Electrolyte disturbances in patient with acute Liver Failure and Nursing Assessment for fluid and electrolyte imbalances in patients with acute Liver Failure. For duration of 1 hour.

- ✚ All nurses were interviewed during break time in different shifts or before beginning of shift on hospital meeting room.
- ✚ Group discussion was encouraged with continuous feedback.
- ✚ An open channel of communication was established between the researcher and nurses to answer any question and reinforce the gained information and correct actions.
- ✚ In the last session the researcher summarized and emphasized the important points.
- ✚ Learning environment:
  - ✚ The training was delivered as a session on formal work responsibilities. lectures and discussions supported by audiovisual materials (PowerPoint presentations and booklets) that the researcher created in Arabic after studying pertinent literature.
  - ✚ The researcher used instructional materials (pictures, videos, and applications for the patient) to conduct a demonstration and re-demonstration.
  - ✚ Ask nurses to fill out the test before and after program implementation.
  - ✚ The researcher fills out the observational checklist.
  - ✚ The researcher was designing a booklet for the nurses.
  - ✚ Implementation of a patient assessment sheet before and after program implementation to assess patients.
  - ✚ The evaluation was approved after its application to evaluate the outcome of the program.
  - ✚ Data was collected by the researcher during approximately one year, from July 2022 and July 2023.

**Statistical analysis**

SPSS (Statistical Package for the Social Sciences, version 20, IBM, Armonk, New York) was used for data analysis. The data's compliance with the normal distribution was assessed using the Shapiro test. When comparing quantitative data with a normal distribution, the Student t-test and ANOVA tests are used to express the data as mean  $\pm$  standard deviation (SD).

Numbers (n) and percentages (%) are used to represent nominal data. These data were subjected to the Chi2 test. The Pearson coefficient of correlation was used to find correlations between continuous variables. Since the 95% level of confidence was maintained, a P value of less than 0.05 was deemed significant.

## Results

Table (1): Socio-demographic data of the studied nurses

|                                 | N= 50         |
|---------------------------------|---------------|
| <b>Age (years)</b>              | 25.33 ± 10.03 |
| <b>Age groups (years)</b>       |               |
| 20-25                           | 25 (50%)      |
| 26-30                           | 17 (34%)      |
| > 30                            | 8 (16%)       |
| <b>Sex</b>                      |               |
| Male                            | 0             |
| Female                          | 50 (100%)     |
| <b>Qualification</b>            |               |
| Bachelor of nursing             | 6 (12%)       |
| Technician institute of nursing | 12 (24%)      |
| Diploma                         | 32 (64%)      |
| <b>Years of experience</b>      |               |
| < 1 year                        | 12 (24%)      |
| 1- 3 years                      | 12 (24%)      |
| 3-5 years                       | 16 (32%)      |
| 5-10 years                      | 10 (20%)      |
| <b>Training course</b>          | 7 (14%)       |

Data expressed as mean (SD), frequency (percentage)

Table (2): Knowledge of nurses about acute liver cell failure before and after implementation of the educational program

| Parameters   | Pre-test    | Post-test   | P value  |
|--|-------------|-------------|----------|
| Definition of acute liver cell failure   | 0.23 ± 0.10 | 1 ± 0.00    | < 0.001* |
| Duration of deterioration of acute liver cell failure                                  | 0.47 ± 0.12 | 0.90 ± 0.08 | < 0.001* |
| Herpes simplex virus isn't a cause of liver cell failure.                              | 0.50 ± 0.22 | 0.86 ± 0.12 | 0.01*    |
| One of the causes of acute liver cell failure is the failure of liver transplantation. | 0.33 ± 0.12 | 0.56 ± 0.10 | 0.04*    |
| Sub-acute liver cell failure occurs between 28 and 72 days from the onset of jaundice. | 0.33 ± 0.13 | 0.66 ± 0.33 | 0.01*    |
| Renal failure is one of the complications of acute liver cell failure.                 | 0.41 ± 0.09 | 0.80 ± 0.13 | < 0.001* |
| Respiratory failure isn't one of the complications of acute liver cell failure.        | 0.22 ± 0.11 | 0.81 ± 0.12 | < 0.001* |
| Type of patient who is liable for deficient fluid volume                               | 0.40 ± 0.22 | 0.90 ± 0.10 | < 0.001* |
| Required amount of daily fluid intake for an adult healthy subject                     | 0.34 ± 0.10 | 1 ± 0.00    | < 0.001* |
| Potassium-rich nutrients   | 0.55 ± 0.22 | 1 ± 0.00    | < 0.001* |
| <b>Total score</b>   | 5.66 ± 1.11 | 8.89 ± 0.56 | < 0.001* |

Data expressed as mean (SD).

P value was significant if < 0.05.

Data were compared by paired t test.

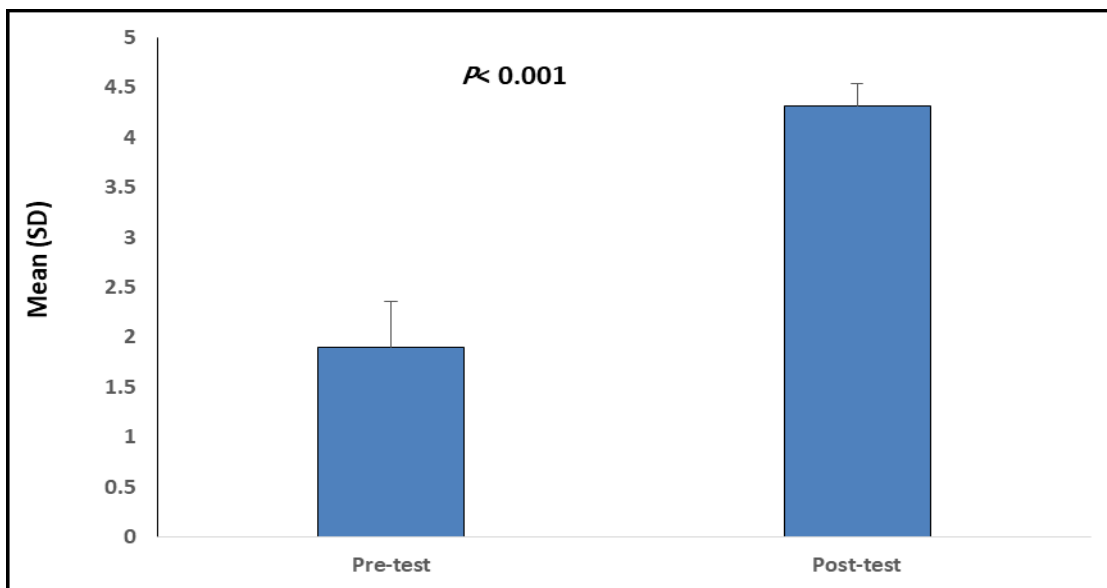


Figure (1): Mean total score of knowledge of nurses about fluid and mineral's disorder in patients with acute liver cell failure before and after implementation of the educational program.

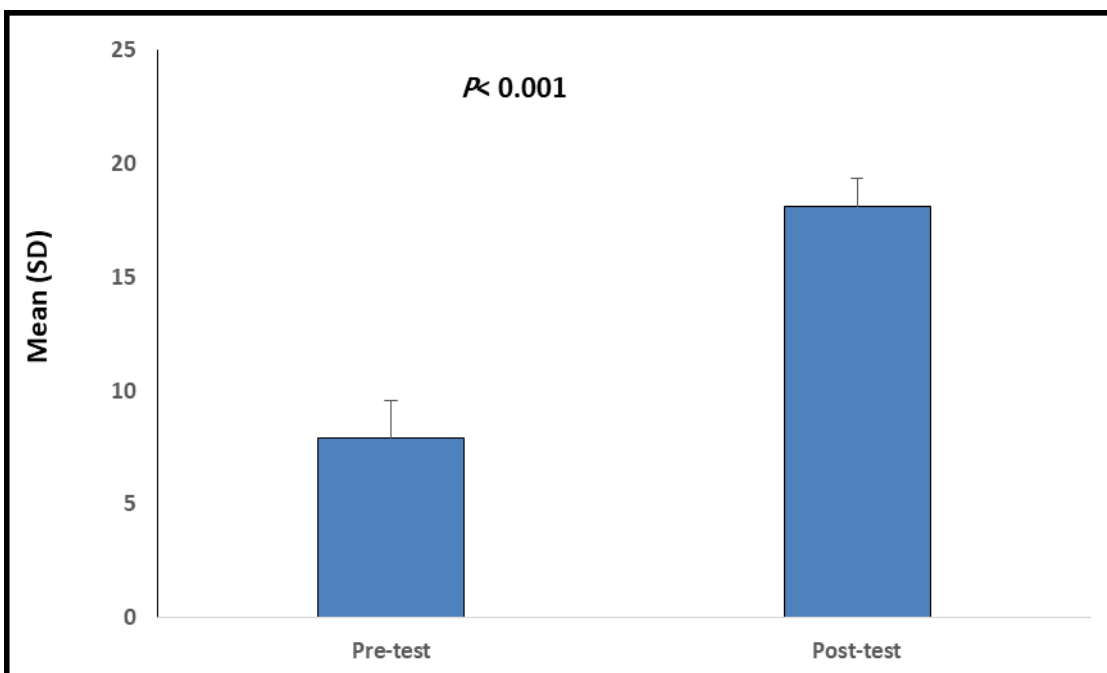


Figure (2): Mean total score of nurses' practices about monitoring fluid balance in patients with acute liver cell failure before and after implementation of the educational program.

Table (3): Mean total nursing's knowledge score and observational checklist score before and after implementation of the educational program

|                       | Pre-test    | Post-test    | P value  |
|-----------------------|-------------|--------------|----------|
| Total knowledge score | 4.55 ± 2.45 | 10.22 ± 3.79 | < 0.001* |
| Total checklist score | 8.91 ± 3.88 | 13.45 ± 4.56 | < 0.001* |

Data expressed as mean (SD). P value was significant if <math>< 0.05</math>. Data were compared by paired t test.

**Table (4): Correlation between total scores with age and duration of experience of studied nurses**

|                               | Age         | Duration of experience |
|-------------------------------|-------------|------------------------|
| <b>Pre-test</b>               |             |                        |
| Total knowledge score         | 0.09 (0.34) | 0.19 (0.17)            |
| Observational checklist score | 0.11 (0.15) | 0.08 (0.87)            |
| <b>Post-test</b>              |             |                        |
| Total knowledge score         | 0.05 (0.78) | 0.22 (0.43)            |
| Observational checklist score | 0.20 (0.90) | 0.01 (0.12)            |

Data expressed as *r* value (strength of correlation), & *p* value (significance of correlation).

**Table (5): Socio-demographic data of patients before and after implementation of the educational program**

| Parameters            | Pre-test (n= 40) | Post-test (n= 40) | P value |
|-----------------------|------------------|-------------------|---------|
| Age (years)           | 45.11 ± 10.25    | 41.90 ± 12.21     | 0.98    |
| <b>Sex</b>            |                  |                   | 0.21    |
| Male                  | 30 (75%)         | 32 (80%)          |         |
| Female                | 10 (25%)         | 8 (20%)           |         |
| <b>Marital status</b> |                  |                   | 0.67    |
| Single                | 12 (30%)         | 10 (25%)          |         |
| Married               | 28 (70%)         | 30 (75%)          |         |

Data expressed as mean (SD) & frequency (percentage). *P* value was significant if  $< 0.05$ .

**Table (6): Outcome of patients before and after implementation of the educational program**

| Parameters                | Pre-test (n= 40) | Post-test (n= 40) | P value     |
|---------------------------|------------------|-------------------|-------------|
| Length of stay (days)     | 15.09 ± 3.40     | 8.33 ± 4.40       | $< 0.001^*$ |
| <b>Complications</b>      |                  |                   |             |
| Acute respiratory failure | 10 (25%)         | 1 (2.5%)          | 0.01*       |
| Infections and sepsis     | 20 (50%)         | 3 (7.5%)          | $< 0.001^*$ |
| Cardiac dysfunction       | 5 (12.5%)        | 3 (7.5%)          | 0.35        |
| Hypotension               | 15 (37.5%)       | 5 (12.5%)         | 0.03*       |
| Hepatorenal failure       | 3 (7.5%)         | 1 (2.5%)          | 0.43        |
| Hemorrhage                | 10 (25%)         | 2 (5%)            | 0.01*       |
| Cerebral edema            | 20 (50%)         | 5 (12.5%)         | $< 0.001^*$ |
| <b>Mortality</b>          | 12 (30%)         | 5 (12.5%)         | 0.03*       |

Data expressed as frequency (percentage), mean (SD). *P* value was significant if  $< 0.05$ .

**Table (1):** The mean age (SD) of the studied nurses was 25.33 (10.03) years. The majority (50%) of nurses were between 20-25 years old, while 17 (34%) and 8 (16%) of them were 26–30 and  $> 30$  years, respectively. Thirty-two (64%), 12 (24%), and 6 (12%) nurses had diplomas, technician institutes of nursing, and bachelors of nursing, respectively. Seven nurses had received training courses. As regard duration of experience, it was found that 12 (24%), 12 (24%), 16 (32%), and 10 (20%) nurses had durations of experience  $< 1$ , 1-3, 3-5, and 5-10 years.

**Table (2):** Illustrates significant progress in nurses knowledge about acute liver cell failure before and after the implementation of the program. The total score of knowledge was significantly increased after application of the program ( $8.89 \pm 0.56$  vs.  $5.66 \pm 1.11$ ;  $p < 0.001$ ).

**Figure (1):** Shows a significant progress in the knowledge of nurses about fluid and mineral's disorders in patients with acute liver cell failure before and after the application of the program. The

total score of knowledge was significantly increased after application of the program ( $17.11 \pm 3.60$  vs.  $8.99 \pm 3.29$ ;  $p < 0.001$ ).

**Figure (2):** Shows significant progress in nurses' skills in monitoring fluid balance in patients with acute liver cell failure before and after the application of the program. The total score of knowledge was significantly increased after application of the program ( $18.09 \pm 1.23$  vs.  $7.89 \pm 1.66$ ;  $p < 0.001$ ).

**Table (3):** Shows a significant increase in the mean whole nursing's knowledge score ( $10.22 \pm 3.79$  vs.  $4.55 \pm 2.45$ ;  $p < 0.001$ ) and observational checklist score ( $13.45 \pm 4.56$  vs.  $8.91 \pm 3.88$ ;  $p < 0.001$ ) after the application of the program.

**Table (4):** Shows there was an insignificant relationship among whole knowledge and observational checklist scores and the age and duration of experience of nurses ( $p > 0.05$ ).

**Table (5):** Illustrates no significant differences among both groups either before or after the application of the program ( $p > 0.05$ ) with regard to

socio-demographic data. The majority of patients were male and married.

**Table (6):** The post-test group of patients had a significantly lower length of stay ( $8.33 \pm 4.40$  vs.  $15.09 \pm 3.40$  days;  $p < 0.001$ ) in judgment to the pre-test group of patients. Also, the post-test group of patients had a significantly lower frequency of acute respiratory (2.5% vs. 25%;  $p = 0.01$ ), infection/sepsis (7.5% vs. 50%;  $p < 0.001$ ), hypotension (12.5% vs. 37.5%;  $p = 0.01$ ), cerebral edema (12.5% vs. 50%;  $p < 0.001$ ), and mortality (12.5% vs. 30%;  $p = 0.03$ ).

## Discussion

Acute liver failure (ALF) is a rare syndrome resulting from an acute insult to the liver in patients without known underlying chronic liver disease. It is characterized by loss of synthetic function in the form of jaundice and coagulopathy and development of hepatic encephalopathy. Multiorgan failure (MOF) eventually develops, leading to death (**Dong et al., 2020**). Many different etiologies have been identified, with acetaminophen overdose and viral hepatitis being the most common causes worldwide. The pathophysiology of ALF can be divided into cause-specific liver injury pathophysiology and pathophysiology related to occurrence of secondary MOF (**Lee, 2022**).

Most patients with acute liver failure (ALF) have substantially elevated lactate levels. However, these changes were observed without acidaemia. This counterintuitive phenomenon was described as “stress hyperlactataemia”, resulting from a massive increase in glycolysis caused by catecholamine- and other cytokine-mediated increases in cellular glucose uptake without hypoxia, as well as a reduction in total body clearance (**Dong et al., 2020**).

The aim of this study was to evaluate the effect of an educational program about fluid, electrolyte and Acid Base disturbances among acute liver failure (ALF) patients on nurses' competency and patients' outcomes. A total of fifty nurses providing care to patients with ALF were enrolled in the study.

The teaching program for nursing staff constitute an important part. These programs are usually urgently designed to assist staff nurses in developing and enhancing the knowledge and skills needed to provide high standard of care to ALF patient.

The current study tabled that, the level of knowledge about fluid, electrolyte and Acid Base disturbances among acute liver failure (ALF) patients on nurses' competency and patients' outcomes. of the majority of studied nurses generally was poor, this might be related to the fact that majority of them hold nursing diploma and most of books are written in English and their learning in Arabic, this cause a problem for them to learn.

The research point of view, this lack of knowledge may be also due to absence of pre-employment orientation programs, in-service ALF training program or courses. Moreover, the nurses in intensive care unit are not used the independent self- learning. Another cause for lack of knowledge nurses' exhaustion due to increased workload which may be hinder their ability to read and update their knowledge.

The present study was conducted on a sample fifteen nurses who working in Intensive Care Unit at Alrajhy liver hospital. The half of nurses their aged ranged from 20-25 years, all of them were female. The majority of nurses have diploma of nursing degree. and the result of the study also indicated that about more than thirty-three of nurses had not trained and had unsatisfactory knowledge about nursing care of acute liver. This finding is inconsistent with **Abd-Elrhaman & Ghoneimy (2019)** stated that more than thirty-three of the nurses didn't have any previous information regarding ALF, and mostly all of them were willing to attend training program and reported that they have the knowledge about ALF and they found low percentage of knowledge among the respondents.

Meanwhile, no previous study discussed evaluate the effect of educational program on nurses' knowledge and practice regarding explore effect of an educational program on nurses' competency about fluid, electrolyte and acid base disturbances on acute liver failure patients' outcomes. To our knowledge this study was the first reported one that explored such issue.

The main finding of the current study was that knowledge collected before the teaching program implementation (pre-test) showed unsatisfactory level of nurse's knowledge about fluid, electrolyte and acid base disturbances in patients with ALF, which reflect the lack of scientific preparation. The implementation of the teaching program showed an improvement in the nurse's level of knowledge regarding the care offered to ALF patients. The finding indicated that a good improvement in the mean knowledge scores after the application of the teaching program. This result was in agreement with **Mustafa & Taha (2016)** that looked at the effect of an educational program on nursing staff with regard to nurse's knowledge about nursing care of ALF patients.

After implementation of teaching program it was noted that the majority of nurses show significant improvement in the nurse's knowledge about the treatment of ALF and care of the patient during receiving treatment. in this respect this finding agree with (**Musso, 2015**) who confirmed that the effectiveness of the teaching program in improving

nurse's knowledge about treatment and care of ALF patients.

Also, the current study proved that nurses' performance was poor in all performance items before the teaching program which has been changed to good immediately after teaching program. This improvement might be related to the fact that majority of them are young and have less experience.

We noticed also, a great improvement in the practice score levels obtained by nurses after the application of the teaching program. This has been concluded by the presence of significant differences between results of pre-test and post-test. This finding indicated that skills can be easily improved, especially if linked with their relevant scientific base of knowledge. This respect this finding agree with (Mahrous, 2016) who confirmed that the effectiveness of the teaching program in improving nurse's performance about treatment and care of ALF patients.

The result of the present study showed that the mean knowledge and practice improved after implementing the teaching program than before implementing the teaching program. It showed that the majority of nurses had satisfactory mean knowledge and practice scores in post implementing the teaching program. This returned to these nurses included in the study were exposed to training program to care for such a group of patient, in accordance with (Abiola et al, 2016).

Another finding in the current study was that there was insignificant correlation between total knowledge and observational checklist scores with age and duration of experience of studied nurses ( $p > 0.05$ ). Also, it was revealed that different degrees of qualification had comparable total knowledge score and observational checklist score with no significant differences between different degrees ( $p > 0.05$ ). This was consistent with previous study that reported qualifications and their relation to nurse's knowledge and practice couldn't reveal any association of statistical significance (Schallmo, 2019).

Regarding correlation between total nurses' Performance and patient outcome pre and post Program. There was a highly statistically significant difference between nurse's performance and patient outcome of designed hepatic encephalopathy program (Saad Mahmoud et al., 2021).

At the same line study done by Nasr et al (2018) in their study showed that there was relation found between knowledge and practice score before and after the teaching program.

As regard effects of education program on patient's, we noticed a significant differences between both groups either before or after implementation of educational program ( $p < 0.05$ ) as regard hepatic encephalopathy, reactive pupils, lower limb edema,

anemia and wheezing. Meanwhile, other clinical data showed no significant differences between both groups.

Also, post-test group of patients had significantly lower length of stay ( $p < 0.001$ ) in comparison to pre-test group of patients. Also, post-test group of patients had significantly lower frequency of acute respiratory, infection/sepsis, hypotension, hemorrhage, cerebral edema and mortality. This result is in the same line with study done by Kim & Chang (2019) entitled as "Implementing an educational program to improve critical care nurses' enteral nutritional support" who mentioned that After the program, nurses showed a significant improvement in their practice of enteral nutrition for ICU patients with subsequent improvement in the outcome.

Finally, it can be concluded that, the teaching program for nurses working with ALF patients has achieved, its objectives by improving nurse's knowledge and practice regarding ALF patient care. This further was supported by (Corbett, 2018); who stated that professional nurses have a large role to play in the minimization and prevention of ALF complications and should be clinically well versed in all aspects of the condition, current strategies to address risk minimization and prevention management and advocates for patient safety.

### Conclusion

The study's findings suggest that putting in place an educational program to improve nurses' knowledge of fluid, electrolyte, and acid-base disturbances significantly improved the prognosis of patients with acute liver failure.

**Acknowledgment:** We are grateful to all of the patients who took part in this study and to the hospital's staff nurses for their invaluable assistance.

**A conflict of interest:** We affirm that we do not have any competing interests.

### Recommendation

#### Recommendations regarding education and training:

- All the nurses should be equipped with the necessary knowledge and skills to deal with acute liver failure patients in Intensive Care Unit at Alrajhy liver hospital.
- Periodic monitoring of nurse's knowledge about acute liver failure and practice to evaluate the level of nurses.

#### Recommendations regarding nursing practice:

- Orientation program for all newly nurses and in services training program for experienced nurses about fluid, electrolyte and Acid Base disturbances on acute liver failure patients.



- Periodic monitoring of nurse's knowledge and practice to evaluate the level of nurses.
- Presence and reviewing of patient's records for proper follow up for patients with acute liver failure.

#### Recommendations regarding the research:

- Repeat this research on large sample size and in different settings for generalization.

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